Phenolic Resin Analysis by Agilent ResiPore Columns and Gel Permeation Chromatography

Application Note

Materials Testing and Research

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Introduction

The term phenolic resin is used to describe a group of thermosetting resins produced through the reaction of phenol with an aldehyde. Phenolic resins were the earliest synthetic polymers to be developed, by Leo Baekeland in 1907, and possess useful mechanical and physical properties. Applications of phenolic resins include electrical insulation, molding, lamination, and adhesives. Due to the relatively low cost and favorable properties of phenolic resins, they are produced in the greatest volume of all thermosetting polymers. Key characteristics of phenolic resins are their molecular weight distribution and oligomeric fingerprint, as these both have significant effects on the end use properties of the resin.

Gel permeation chromatography (GPC) is an ideal analytical tool for the examination of both of these characteristics. In this case, the use of high resolution Agilent ResiPore columns is advantageous, since these allow an optimized oligomeric separation, and provide detailed information regarding the oligomeric sample composition.

Phenolic Resin Analysis

Four distinct grades of phenolic resin are analyzed by GPC using an Agilent ResiPore column set. Resulting from the small particle size (3 µm) and optimized pore size distribution of this column packing material, good resolution is obtained in the molecular weight range of interest.

The chromatography obtained from the GPC of each phenolic resin sample is shown in Figure 1. Differential molecular weight distributions are given in Figure 2. This plot clearly shows significant differences in molecular weight distribution and the relative amounts of oligomeric material.

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Conditions

Columns	2 × Agilent ResiPore, 7.5 × 300 mm (p/n PL1113-6300) (conditioned with 10 injections of a typical sample solution at 10 mg/mL)
Eluent	THF (stabilized with 250 ppm BHT)
Flow rate	1.0 mL/min
Inj vol	20 µL
Detector	RI
System	Agilent PL-GPC 50

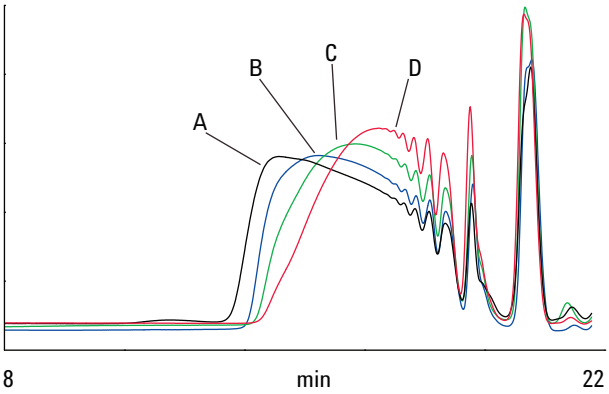

Figure 1. Overlay of GPC chromatograms obtained from four samples of phenolic resin on Agilent ResiPore columns.

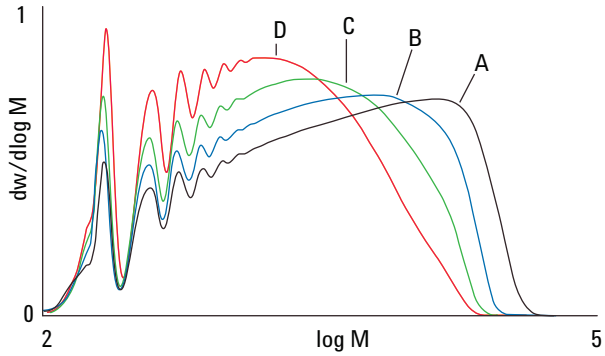

Figure 2. Overlaid molecular weight distributions of four phenolic resins reveals the relative amounts of the oligomer components with significant differences in molecular weight distribution.

Conclusions

High resolution Agient ResiPore columns permit different grades of phenolic resin to be compared and their relative oligomeric content to be assessed, a property that affects the end-use applications of these materials.

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